PCT/EP 02/09402 22 FEB 2005

PATENT COOPERATION TREATY

erh. mit Email vom 26/10/2004 an Mrs. Kellet und Mrs. Lim mail

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

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18. Okt. 2004
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PATENTANWÄLTE RECHTSANWÄLTE

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Rule 71.1)

Date of mailing *(day/month/year)*	13.10.2004
Applicant's or agent's file reference: 93 447 a/se	**IMPORTANT NOTIFICATION**

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP 02/09402	22.08.2002	22.08.2002

Applicant
DOCOMO COMMUNICATIONS LABORATORIES EUROPE GMBH

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

The applicant's attention is drawn to Article 33(5), which provides that the criteria of novelty, inventive step and industrial applicability described in Article 33(2) to (4) merely serve the purposes of international preliminary examination and that "any Contracting State may apply additional or different criteria for the purposes of deciding whether, in that State, the claimed inventions is patentable or not" (see also Article 27(5)). Such additional criteria may relate, for example, to exemptions from patentability, requirements for enabling disclosure, clarity and support for the claims.

Name and mailing address of the international preliminary examining authority:

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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 93 447 a/se	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/EP 02/09402	International filing date *(day/month/year)* 22.08.2002	Priority date *(day/month/year)* 22.08.2002
International Patent Classification (IPC) or both national classification and IPC H04L12/00		
Applicant DOCOMO COMMUNICATIONS LABORATORIES EUROPE GMBH		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 16 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
10.03.2004	13.10.2004
Name and mailing address of the international preliminary examining authority: European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer Olmos, J Telephone No. +31 70 340-4065

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/EP 02/09402

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

4-30	as originally filed
1, 1a, 2, 3	received on 30.09.2004 with letter of 30.09.2004

Claims, Numbers

1-55	received on 30.09.2004 with letter of 30.09.2004

Drawings, Sheets

1/6-6/6	as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).

   ☐ the language of publication of the international application (under Rule 48.3(b)).

   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority in written form.

   ☐ furnished subsequently to this Authority in computer readable form.

   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:

   ☐ the claims, Nos.:

   ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-55
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-55
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-55
	No:	Claims	

2. Citations and explanations

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. **Claim 1** meets the requirements of novelty and inventive step, Articles 33(2) and (3) PCT, for the following reasons:

1.1 Closest priort art document **D1 = WO 01/14968** discloses (the references in parentheses applying to this document) a method of reconfiguration for a network node, comprising the steps: preparing a transition from an initial software configuration to a target software configuration (page 13, lines 6-13); deciding on commitment to the target software configuration in view of a result of reconfiguration indicated through at least one further network node (page 14, lines 19-22).

1.2 The objective technical problem is how to autonomously reconfigure a network node, ensuring future interoperation with further network nodes.

1.3 The solution of claim 1 is that the step of committing to the target software configuration is taken when every result of reconfiguration received at the network node from a reachable further network node is evaluated to be positive.

1.4 D1 does neither suggests the technical problem nor the solution. In D1, a host receives a result of reconfiguration from the network node and, thereafter, it signals the network node to commit the target software configuration. In the solution of claim 1 the network node itself receives results of reconfiguration from a reachable further network node and, when every result of reconfiguration received is positive, the target software configuration of the network node is committed. Hence, the solution of claim 1 solves the problem of autonomously reconfiguring a network node, ensuring future interoperation with further network nodes, because a positive result of reconfiguration must be received from a reachable further network node before committing the new configuration. The Examiner considers that this solution is not obvious.

1.5 The remaining documents cited in the search report are less relevant than D1 and, in particular, they do not disclose or hint at the solution of claim 1. **D2 = US 6,113,652** discloses a method where no result of reconfiguration is indicated to the network node and where a central controller decides on the commitment to the

target software configuration without receiving results of reconfiguration. **D3 = US 6,141,683** discloses a method where the network node may roll-back to an older version of software after reconfiguration, if it detects a problem with the new target configuration.

2. Independent **claim 29** corresponds, in terms of network node features, to method claim 1 and, therefore, it also meets the requirements of the PCT in respect to novelty and inventive step.

3. Independent **claim 55** corresponds, in terms of computer program product features, to method claim 1 and, therefore, it also meets the requirements of of the PCT with respect to novelty and inventive step.

4. **Claims 2-28** and **30-54** are dependent on claims 1 and 29, respectively, and as such also meet the requirements of the PCT with respect to novelty and inventive step.

Reconfiguration of a Group of Network Nodes in an Ad-hoc Network

FIELD OF INVENTION

The present invention relates to a reconfiguration of a group of network nodes in an ad-hoc network, and in particular to a reconfiguration of a group of network nodes in an ad-hoc network with particular emphasis on reconfiguration consistency.

BACKGROUND ART

In WO 01/14968 A1 there is described a fieldbus upgradable apparatus and method, wherein control devices residing on a fieldbus communications network are modified without interrupting the operation of the control devices in a seamless manner.

In US-A-6,113,652 there is described a communication network equipment capable of non-disruptive software upgrade which is used in a telecommunications network having a plurality of

coupled nodes and a network controller coupled to at least one of these nodes.

Further, in US-6,141,683 A there is described a method for remotely and reliably updating the software on a computer with provision for roll-back with particular focus on integrity between different software versions.

Further, in US-A-5,699,275 there is described a system and method for remote patching of operating code located in a mobile unit, wherein a manager host is operable to initiate transmission through a communication network of at least one discrete patch message defining at least one patch.

Further, in US-2001/0029178 A1 there is described a wireless software update with version control in a wireless communication system having a system backbone, having a host computer coupled to the system backbone, at least one base station coupled to the system backbone, and a plurality of mobile devices within the system.

Further, in WO 01/84792 A1 there is described a method and gateway for performing an online switching of software in a communication system.

Overall, numerous factors associated with technology, business, regulation and social behavior have driven the spreading of wireless ad-hoc networking in the past, i.e., a wireless network formed without any central administration. Ad-hoc networks consist of a plurality of mobile devices using a wireless interface for exchange of packet data. As each mobile device in the ad-hoc network serves as router and host, each such mobile device will forward data packets on

behalf of other mobile devices and further run user applications. Therefore, in ad-hoc networks, mobile devices are connected directly for local cooperation.

To support on-going improvement of functionality, an ad-hoc network should provide the opportunity for a software update. It is often required that all mobile devices in such an ad-hoc network have the same software version, e.g., for reasons of compatibility. For this reason, the software update should take place in a coordinated manner, preferably at the same point in time. In addition, either all mobile devices reconfigure successfully, or they all fall back to the software version before installation.

However, up to now no appropriate approach to the coordinated update of software in ad-hoc networks is available. Another issue not addressed so far is that during reconfiguration mobile devices may not communicate properly.

SUMMARY OF INVENTION

In view of the above, the object of the present invention is to provide a solution to consistent software reconfiguration in ad-hoc networks.

According to the present invention, this object is achieved through a method of reconfiguration for a network node, e.g., a mobile device or a stationary device, in an ad-hoc network. The method comprises a first step of preparing a

transition from an initial software configuration to a target software configuration and a second step to deciding on commitment to the target software configuration. According to the present invention, the decision on commitment is taken in view of a result of reconfiguration indicated through at least one further network node in the ad-hoc network, in particular when every result of configuration received at the network node from a reachable further network node is evaluated to be positive.

Therefore, according to the present invention, a transition from an initial software configuration to a target software configuration is not executed anyway but such a transition is taken on the basis of information being related to reconfiguration at network nodes being reachable from the network node deciding on commitment to the target software configuration.

In particular, if the information received is related to further reconfiguration processes in the further network nodes, it is possible to allow for coordination of reconfiguration between different network nodes, although each single network node is operating autonomously.

In other words, according to the present invention it is proposed to not simply initiate an update process for different network nodes in an ad-hoc network and to just hope that the reconfiguration will be successful, but to use feedback mechanisms locally in each single network node to decide on commitment to target software configurations.

According to a preferred embodiment of the invention it is proposed to negotiate a maximum reconfiguration time period

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DOCOMO Communications Laboratories Europe GmbH September 30,2004

CLAIMS

1. Method of reconfiguration for a network node in an ad-hoc network, comprising the step:

   preparing a transition from an initial software configuration to a target software configuration;

   characterized by

   deciding on commitment to the target software configuration in view of a result of reconfiguration indicated through at least one further network node in the ad-hoc network; wherein the step of committing to the target software configuration is taken when every result of reconfiguration received at the network node from a reachable further network node is evaluated to be positive.

2. Method according to claim 1, ***characterized in that*** it further comprises a step of negotiating a maximum reconfiguration time period with at least one further network node before executing the transition from the initial software configuration to the target software configuration.

3. Method according to claim 2, ***characterized in that*** the maximum reconfiguration time period is the maximum time for reconfiguration, indication of reconfiguration result, and executing a fallback to the initial software configuration for network nodes in the ad-hoc network participating in the reconfiguration process.

4. Method according to one of the claims 1 to 3, ***characterized in that*** it further comprises a step of coordinating a start of reconfiguration at the network node with a start of reconfiguration in at least one further network node.

5. Method according to one of the claims 2 to 4, ***characterized in that*** it further comprises a step of starting a timer in the network node for measurement of actual reconfiguration time versus maximum reconfiguration time period.

6. Method according to one of the claims 1 to 5, ***characterized in that*** it further comprises a step of determining network nodes being reachable from the reconfigured network node when ad-hoc network communication is interrupted during the transition from the initial software configuration to the target software configuration.

7. Method according to one of the claims 1 to 6, ***characterized in that*** it further comprises a step of falling back to the initial software configuration when at least one result of reconfiguration received at the

network node from a reachable further network node is evaluated to be negative.

8. Method according to one of the claims 1 to 6, ***characterized in that*** it comprises a step of falling back to the initial software configuration when no result of reconfiguration result is received at the network node until expiry of the maximum reconfiguration time period.

9. Method according to one of the claims 1 to 8, ***characterized in that*** it further comprises a step of sending a positive reconfiguration result when the transition from the initial software configuration to the target software configuration is successful.

10. Method according to claim 9, ***characterized in that*** the positive reconfiguration result is sent as positive signal or indicated through automatic set-up of network connectivity.

11. Method according to claim 9 or 10, ***characterized in that*** the positive reconfiguration result is sent repeatedly.

12. Method according to one of the claims 1 to 8, ***characterized in that*** it further comprises a step of sending a negative reconfiguration result when the transition from the initial software configuration to the target software configuration is not successful.

13. Method according to claim 12, ***characterized in that*** the negative reconfiguration result is sent as fallback signal.

14. Method according to claim 12 or 13, ***characterized in that*** the negative reconfiguration result is sent repeatedly.

15. Method according to one of the claims 12 to 14, ***characterized in that*** it further comprises a step of forwarding results of reconfiguration received from further network nodes to the ad-hoc network.

16. Method according to one of the claims 1 to 15, ***characterized in that*** it further comprises a step of determining network nodes in the ad-hoc network executing reconfiguration.

17. Method according to claim 16, ***characterized in that*** the step of determining network nodes in the ad-hoc network executing reconfiguration is based on at least one criteria selected from a group comprising:

- communication capability of network node;
- network connectivity;
- profile data of network node;
- movement pattern of network node;
- hardware status of network node;
- priority of network node; and
- group membership of network node.

18. Method according to claim 16 or 17, ***characterized in that*** the step of determining network nodes in the ad-hoc network executing reconfiguration is executed before start of reconfiguration.

19. Method according to one of the claims 16 to 18, ***characterized in that*** the step of determining network nodes in the ad-hoc network executing reconfiguration is repeated during reconfiguration.

20. Method according to one of the claims 1 to 19, ***characterized in that*** it further comprises a step of retrieving software for executing the transition from the initial software configuration to the target software configuration locally from a portable electronic device (IC/USIM).

21. Method according to one of the claims 1 to 19, ***characterized in that*** it further comprises a step of retrieving software for executing the transition from the initial software configuration to the target software configuration remotely via a mobile communication environment.

22. Method according to claim 21, ***characterized in that*** it further comprises a step of selecting the mobile communication environment from a group comprising a mobile communication network, wireless local area network, personal area network, wireless infrared communication network (IrDA), Bluetooth communication network.

23. Method according to claim 21, ***characterized in that*** it further comprises a step of selecting the mobile communication network from a group comprising GSM, PDC, IMT 2000, PHS, IS-95.

24. Method according to one of the claims 20 to 23, ***characterized in that*** it further comprises a step of pre-installing software for executing the transition from the initial software configuration to the target software configuration in the network node.

25. Method according to one of the claims 20 to 24, ***characterized in that*** it further comprises a step of selecting software for executing the transition from the initial software configuration to the target software configuration from a group comprising application software, communication software, operating system software, firmware.

26. Method according to claim 25, ***characterized in that*** it further comprises a step of retrieving software for executing the transition from the initial software configuration to the target software configuration in combination with related control parameters.

27. Method according to one of the claims 1 to 24, ***characterized in that*** software for executing the transition from the initial software configuration to the target software configuration is network node specific.

28. Method according to one of the claims 1 to 27, characterized in that the network node is a mobile device or a stationary device.

29. Network node for operation in an ad-hoc network, comprising:

a software reconfiguration unit adapted to prepare a transition from an initial software configuration to a target software configuration;

characterized by

a reconfiguration commitment unit adapted to decide on commitment to the target software configuration in view of a result of reconfiguration indicated through at least one further network node in the ad-hoc network; wherein the reconfiguration commitment unit is adapted to commit to the target software configuration when every result of reconfiguration received at the network node from a reachable further network node is evaluated to be positive.

30. Network node according to claim 29, ***characterized in that*** it further comprises a negotiating unit adapted to negotiate a maximum reconfiguration time period with the at least one further network node before executing the transition from the initial software configuration to the target software configuration.

31. Network node according to claim 30, ***characterized in that*** the negotiation unit is adapted to negotiate the maximum reconfiguration time period as the maximum time for reconfiguration, indication of reconfiguration result, and executing a fallback to the initial software configuration for network nodes in the ad-hoc network participating in the reconfiguration process.

32. Network node according to one of the claims 29 to 31, ***characterized in that*** it further comprises a reconfiguration coordination unit adapted to coordinate a start of reconfiguration at the network node with a start of reconfiguration in the at least one further network node.

33. Network node according to one of the claims 30 or 32, ***characterized in that*** it further comprises a timer unit adapted to measure an actual reconfiguration time versus the maximum reconfiguration time period.

34. Network node according to one of the claims 29 to 33, ***characterized in that*** it further comprises a connectivity unit adapted to determine network nodes being reachable from the reconfigured network node when ad-hoc network communication is interrupted during the transition from the initial software configuration to the target software configuration.

35. Network node according to one of the claims 29 to 33, ***characterized in that*** the reconfiguration commitment unit is adapted to decide on falling back to the initial software configuration when at least one result of reconfiguration received at the network node from a reachable further network node is evaluated to be negative.

36. Network node according to one of the claims 29 to 33, ***characterized in that*** the reconfiguration commitment unit is adapted to decide on falling back to the initial software configuration when no result of reconfiguration

result is received at the network node until expiry of the maximum reconfiguration time period.

37. Network node according to one of the claims 29 to 36, ***characterized in that*** it further comprises a communication unit adapted to send a positive reconfiguration result when the transition from the initial software configuration to the target software configuration is successful.

38. Network node according to claim 32, ***characterized in that*** the communication unit is adapted to send the positive reconfiguration result as positive signal or adapted to indicate the positive reconfiguration result through automatic set-up of network connectivity.

39. Network node according to claim 37 or 38, ***characterized in that*** the communication unit is adapted to send the positive reconfiguration result repeatedly.

40. Network node according to one of the claims 29 to 36, ***characterized in that*** it further comprises a communication unit adapted to send a negative reconfiguration result when the transition from the initial software configuration to the target software configuration is not successful.

41. Network node according to claim 40, ***characterized in that*** communication unit is adapted to send the negative reconfiguration result as fallback signal.

42. Network node according to claim 40 or 41, ***characterized in that*** communication unit is adapted to send the negative reconfiguration result repeatedly.

43. Network node according to one of the claims 37 to 42, ***characterized in that*** the communication unit is further adapted to forward results of reconfiguration received from further network nodes to the ad-hoc network.

44. Network node according to one of the claims 29 to 43, ***characterized in that*** it further comprises a determination unit adapted to determine network nodes in the ad-hoc network executing reconfiguration.

45. Network node according to claim 44, ***characterized in that*** the determination unit is adapted to determine network nodes in the ad-hoc network executing reconfiguration based on at least one criteria selected from a group comprising:

- communication capability of network node;
- network connectivity;
- profile data of network node;
- movement pattern of network node;
- hardware status of network node;
- priority of network node; and
- group membership of network node.

46. Network node according to claim 44 or 45, ***characterized in that*** the determination unit is adapted to determine network nodes in the ad-hoc network executing reconfiguration before start of reconfiguration.

47. Network node according to one of the claims 44 to 46, ***characterized in that*** the determination unit is adapted to determine network nodes in the ad-hoc network executing reconfiguration repeatedly during reconfiguration.

48. Network node according to one of the claims 27 to 47, ***characterized in that*** it further comprises a software retrieval unit adapted to retrieve software for executing the transition from the initial software configuration to the target software configuration locally from a portable electronic device .

49. Network node according to one of the claims 29 to 48, ***characterized in that*** the software retrieval unit is further adapted to retrieve software for executing the transition from the initial software configuration to the target software configuration remotely via a mobile communication environment.

50. Network node according to claim 49, ***characterized in that*** the software retrieval unit is adapted to select the mobile communication environment from a group comprising a mobile communication network, wireless local area network, personal area network, wireless infrared communication network (IrDA), Bluetooth communication network.

51. Network node according to claim 50, ***characterized in that*** the software retrieval unit is further adapted to select the mobile communication network from a group comprising GSM, PDC, IMT 2000, PHS, IS-95.

52. Network node according to one of the claims 47 to 51, ***characterized in that*** it further comprises a software storage unit adapted to store software for executing the transition from the initial software configuration to the target software configuration in the network node, the software being selected from a group comprising application software, communication software, operating system software, firmware.

53. Network node according to claim 52, ***characterized in that*** the software storage unit is further adapted to store software for executing the transition from the initial software configuration to the target software configuration in combination with related control parameters.

54. Network node according to one of the claims 29 to 53, ***characterized in that*** it is a mobile device or a stationary device.

55. A computer program product directly loadable into the internal memory of a network node of an ad-hoc network, comprising software code portions for performing the steps of one of the claims 1 to 28, when the product is run on a processor of the network node.